民航處
CIVIL AVIATION DEPARTMENT

Systematic Performance Monitoring of ADS-B Equipped Aircraft and Sharing of Monitoring Results for the APAC Region

Presented by Hong Kong, China

for ICAO SEA/BOB ADS-B WG9
30 Oct – 1 Nov 2013

Background (1/3)

- During ADS-B SITF/12 (Apr 2013), Hong Kong China presented WP/16 and proposed the following for consideration by TF:
  - ✓ A systematic algorithm to monitor avionics performance of ADS-B aircraft;
  - ✓ A scheme for States/Administrations to report problems under defined categories; and
  - ✓ A scheme for share monitoring results to a centralized database and “Blacklist” problematic aircraft

- The TF agreed to study the proposed algorithm and scheme in further details, and would consider incorporating it as guidance material into the APAC AIGD

Background (2/3)

- During APANPIRG/24, the ICAO/RO was requested to seek possibility of establishing a centralized database for sharing monitoring results at the ICAO Regional Sub-office (RSO)

- The following Conclusion was endorsed to encourage States/Administration to exchange their ADS-B performance monitoring results and experience gained from the process:

Conclusion 24/45 - Exchange ADS-B Performance Monitoring Result

"That, States be encouraged to exchange findings/result of their ADS-B performance monitoring including experience gained in conducting the required performance monitoring."

Background (3/3)

- The purpose of this WP is to :
  - ✓ further elaborate systematic algorithm and monitoring scheme steered by Hong Kong China, and
  - ✓ highlight analysis results based on proposed algorithm and ADS-B flight information collected within the HKFIR from December 2012 to August 2013 (9 months)

Monitoring & Analysis of ADS-B Avionics Performance (1/2)

- After reporting in APANPIRG/23 in Sep 2012, CAD has commenced early monitoring and analysis of ADS-B aircraft avionics performance since early 2013, allowing all parties to get better prepared
- An in-house developed system to detect and verify bad ADS-B data, based on the systematic monitoring algorithm proposed below:-

  ✓ Compare each ADS-B flight with its corresponding radar and flight plan information, and analyse if the following pre-defined criteria are met :-

  (a) Deviation between ADS-B and radar position is **greater than 1NM** for more than 5% of total number ADS-B updates within the HKFIR; or

  (b) Navigation Uncertainty Category (NUC) of each ADS-B reported position is **smaller than 4** for more than 5% of total number of ADS-B updates within the HKFIR; or

  (c) Flight Identification (FLTID) entered via cockpit interface and downlinked in ADS-B data **does not match** with callsign in ATS Flight Plan

Monitoring & Analysis of ADS-B Avionics Performance (2/2)

- The system tracked more than 350,000 ADS-B aircraft movements (or 4,000 ADS-B aircraft) for 9 months (from Dec 2012 to Aug 2013)
- Erroneous ADS-B data observed from analytical results are as expected and in line with observations for ADS-B equipage over the recent years
- Three major problems categories are identified :

  ✓ 1. ADS-B position report with good integrity but position is actually bad as compared with radar

  ✓ 2. FLTID transmitted by ADS-B aircraft does not match with callsign in ATS flight plan

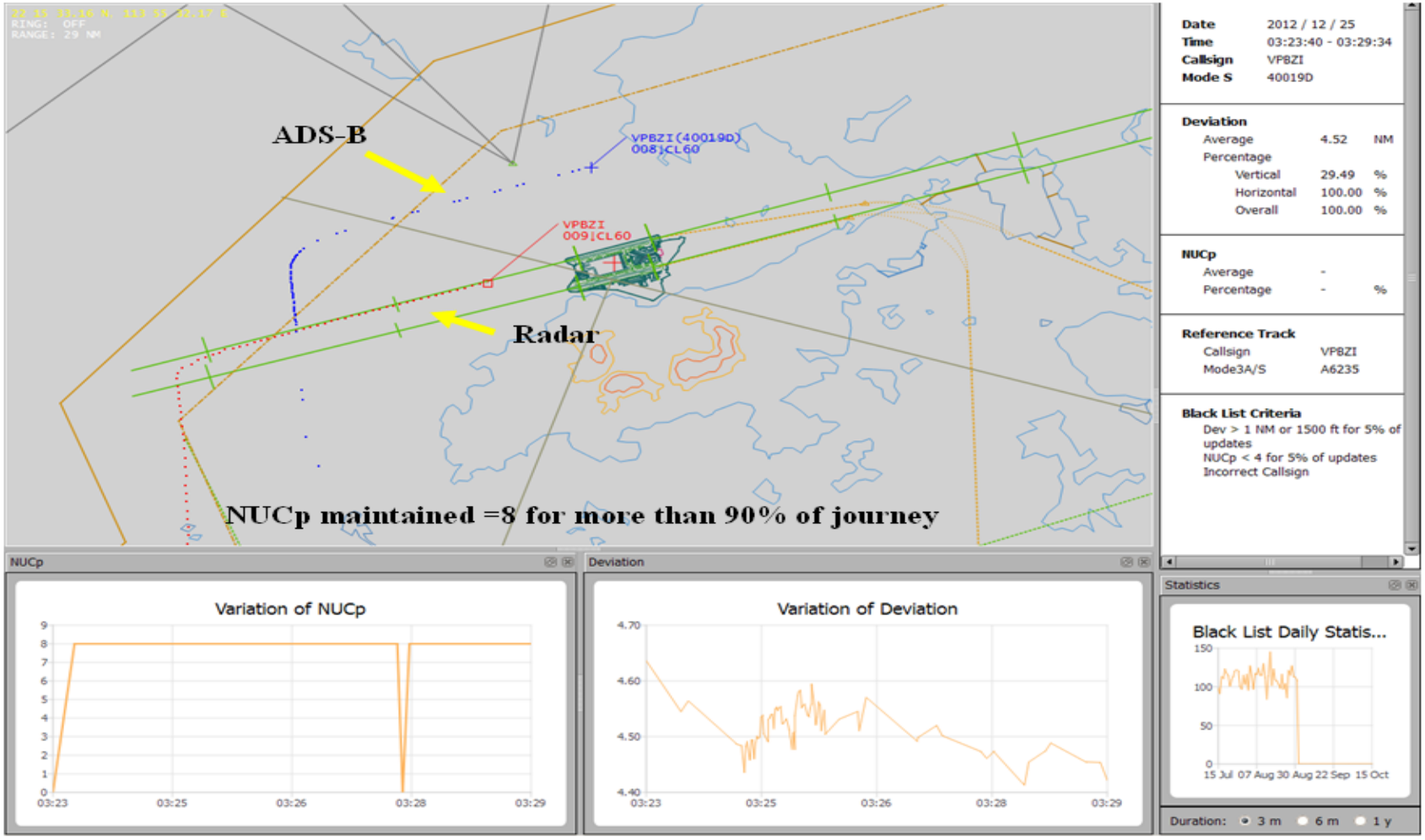
  ✓ 3. ADS-B position report with no integrity (i.e. NUC always “0”)

Monitoring and Analysis Results – Cat 1

Category	Description	Safety implications to ATC (Yes/No)	Statistics	Recommendation
Cat. 1	ADS-B position report with good integrity (i.e. NUC >= "4") but ADS-B position data are actually bad as compared with radar	**Yes.** The "bad" ADS-B data could not be discarded simply based on reported integrity	6 aircraft (1 local and 5 foreign registered) have been detected under this category.	(i) Monitoring results be shared with other States capable of performing ADS-B monitoring and analysis to verify. (ii) Once verified, the list should then be promulgated on a central database for sharing with all parties, while concerned CAAs/operators should take immediate remedial actions. (iii) Consider to **"blacklist"** the aircraft before the problem is rectified

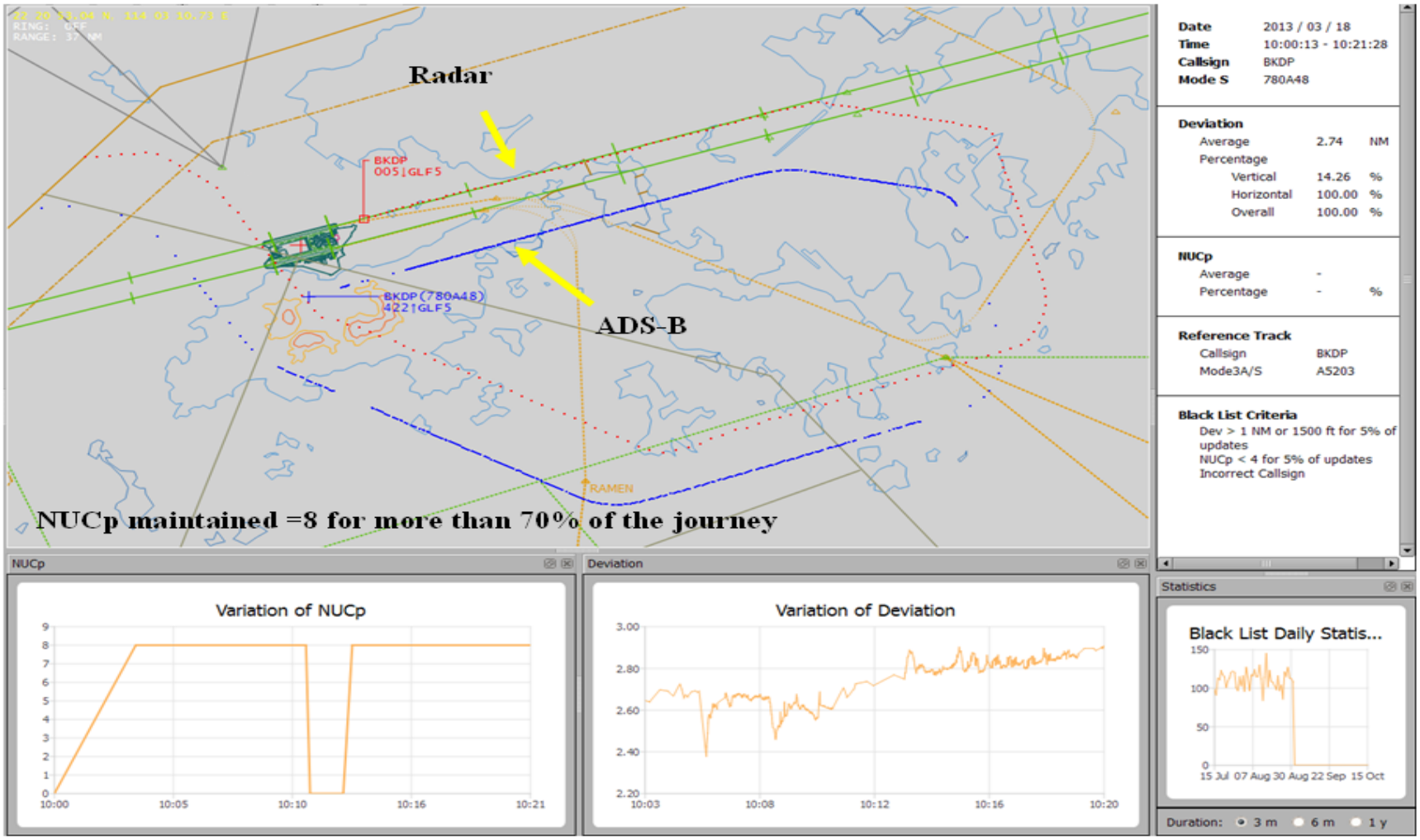
Typical Examples of Cat 1 (1/3)

Average deviation from radar : 4.52NM



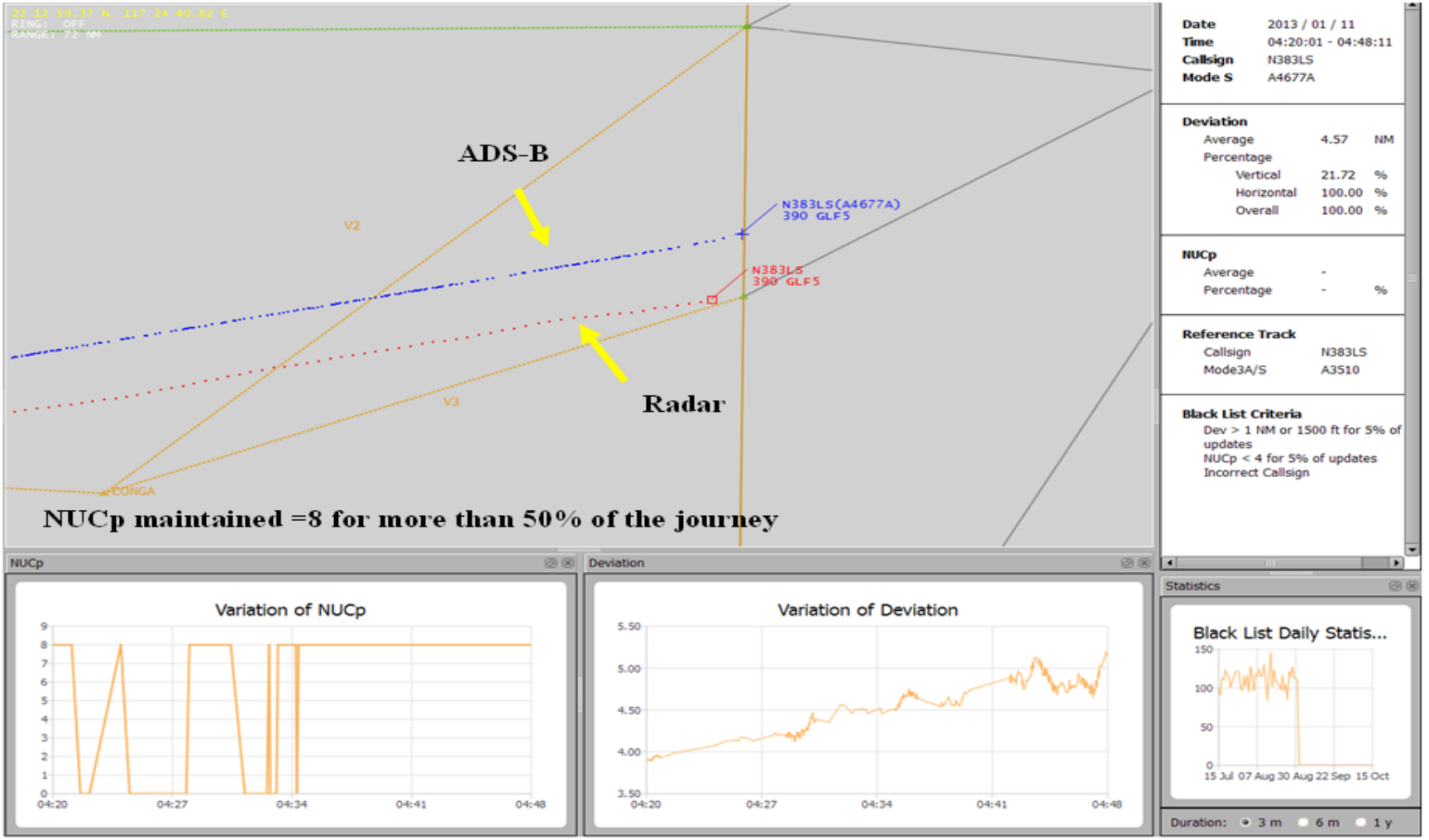
Typical Examples of Cat 1 (2/3)

Average deviation from radar : 2.74NM



Typical Examples of Cat 1 (3/3)

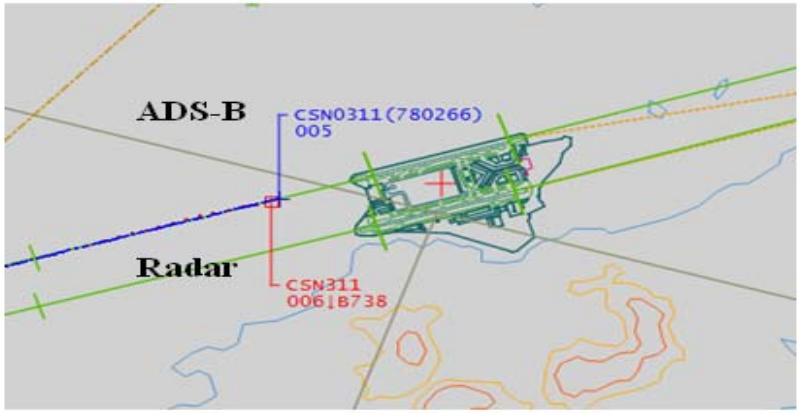
Average deviation from radar : 4.57NM



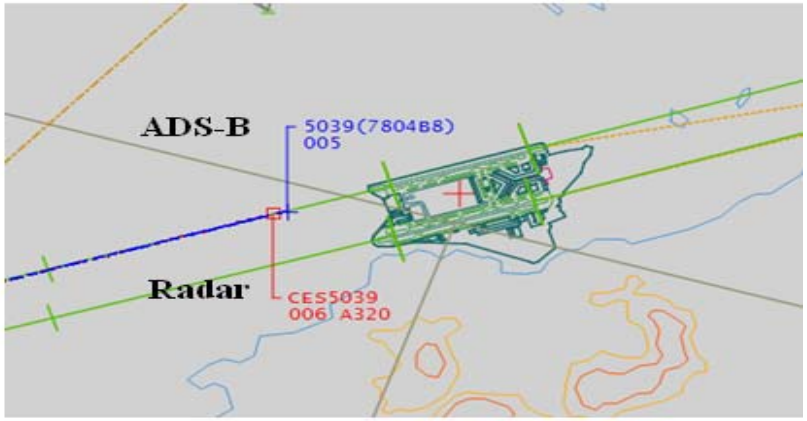
Monitoring and Analysis Results – Cat 2

Category	Description	Safety implications to ATC (Yes/No)	Statistics	Recommendation
Cat. 2	FLTID transmitted by ADS-B aircraft does not match with callsign in flight plan.	**Yes.** Could lead to screen clutter - two target labels with different IDs (one for radar and another for ADS-B) being displayed, causing potential confusion and safety implications to ATC.	15,598 (4.4%) ADS-B flights, or 1,827 aircraft are identified under this category.	(i) Monitoring results be promulgated on the central database (ii) CAAs concerned should follow up airworthiness issue with operators in question urging them for early rectification (iii) Consider to **"blacklist"** the aircraft should no improvement and persistent incorrect FLTID still shown after notification

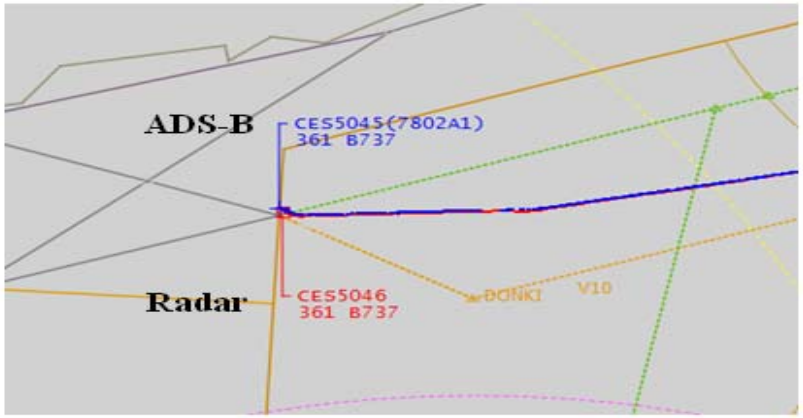
Typical Examples of Cat 2



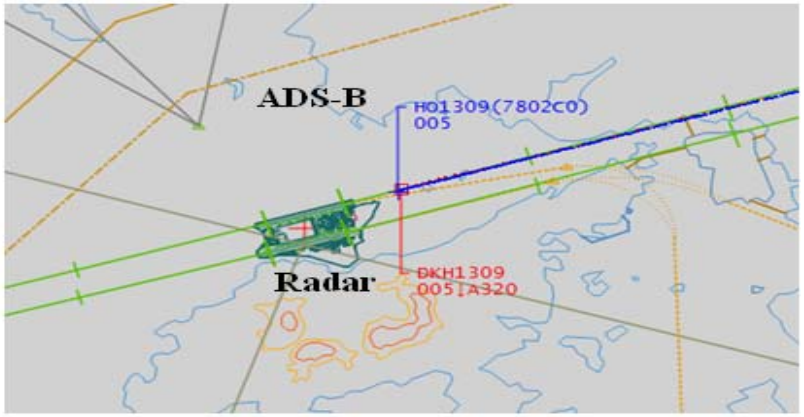
Additional zero inserted



ICAO Airline Designator Code dropped



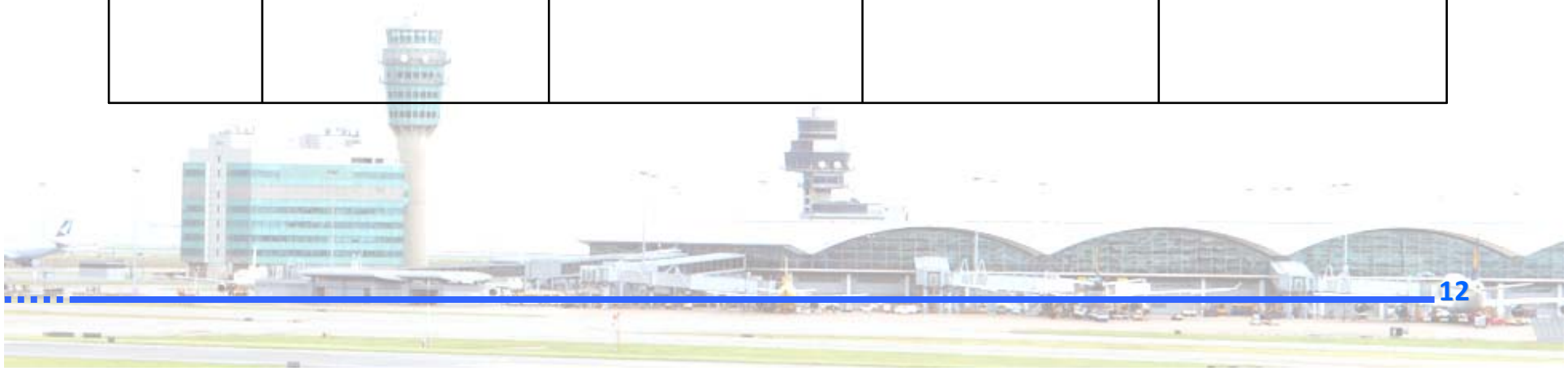
Wrong numerical codes entered



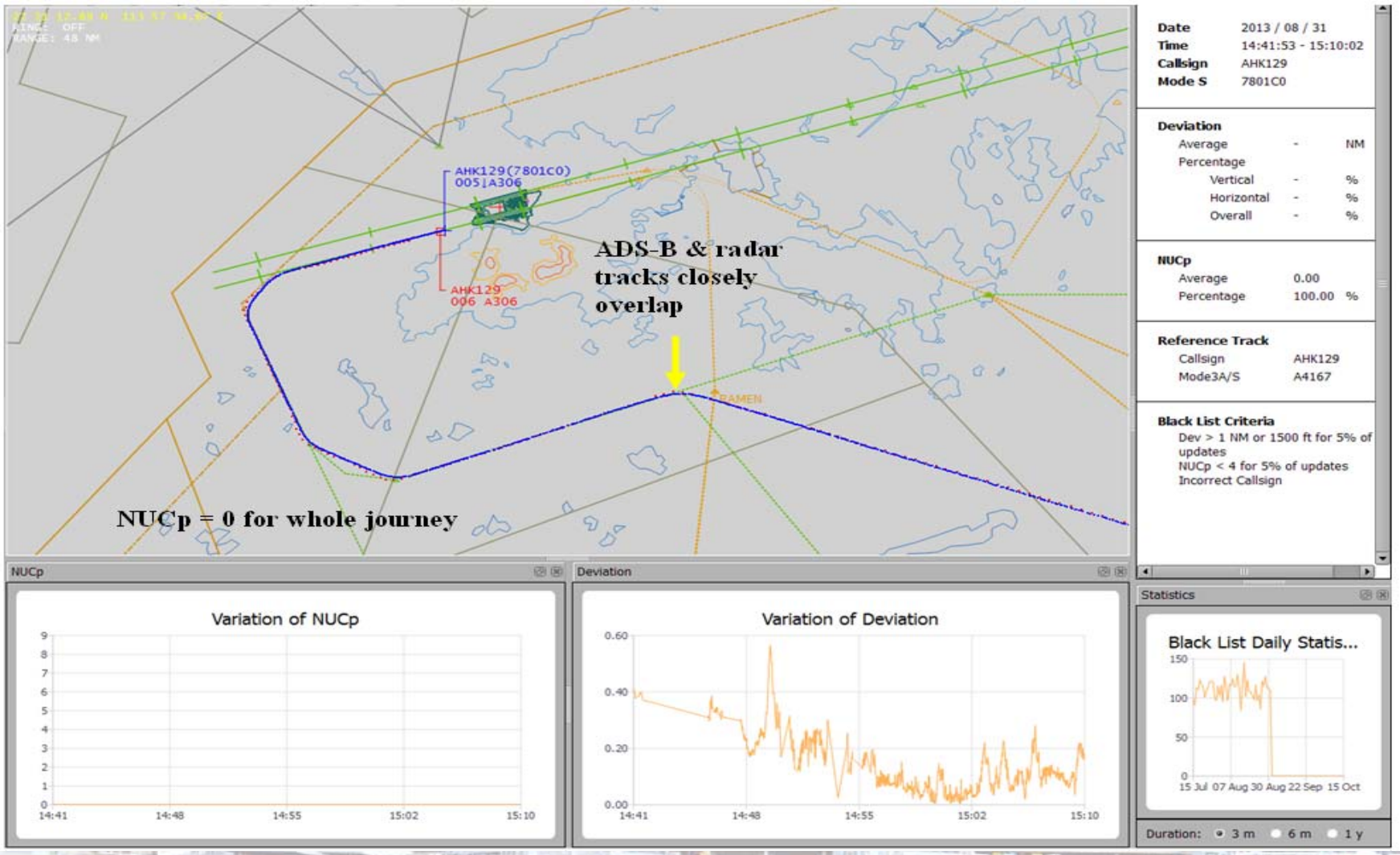
IATA Airline Designator Code used

Monitoring and Analysis Results – Cat 3

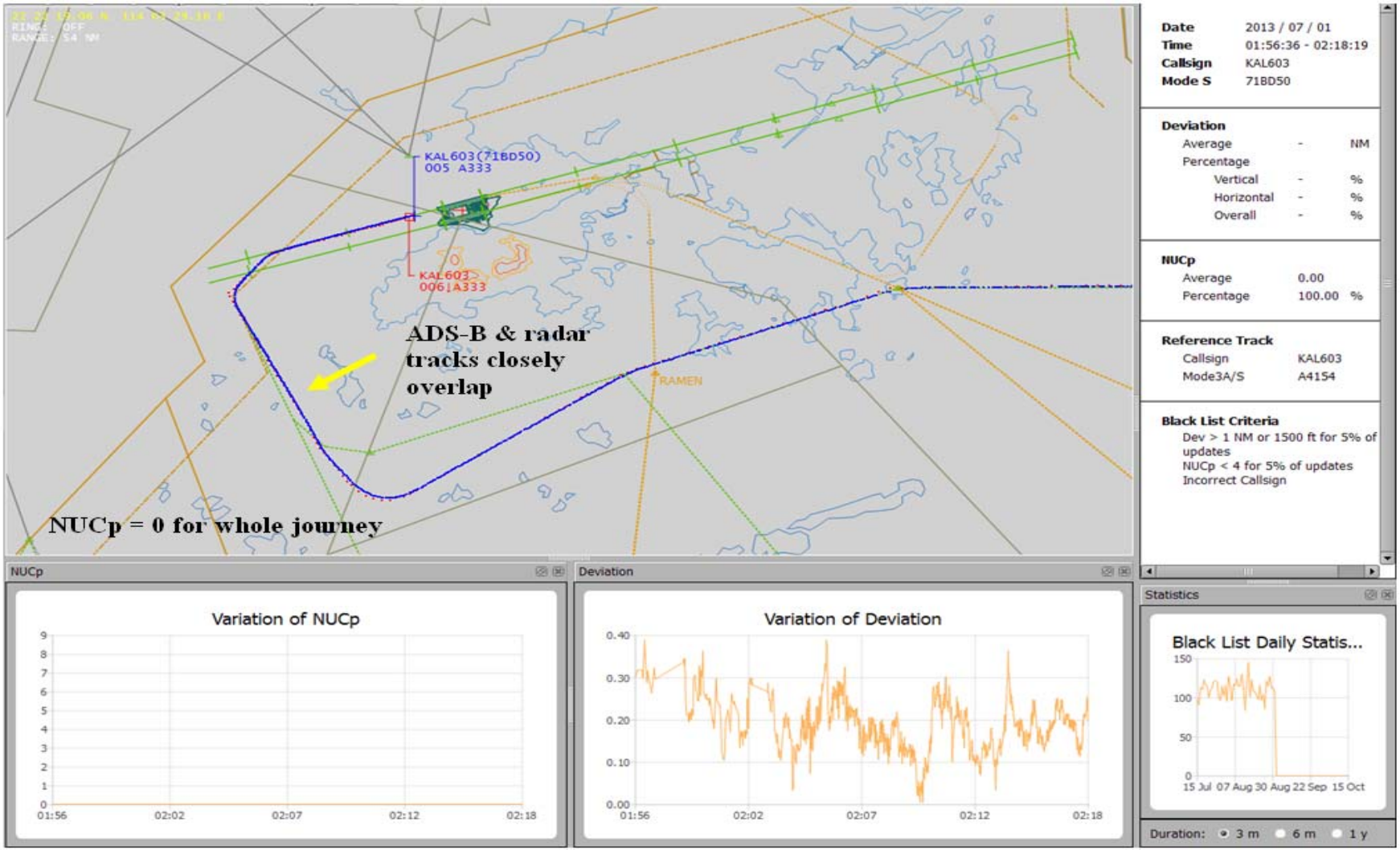
Category	Description	Safety implications to ATC (Yes/No)	Statistics	Recommendation
Cat. 3	ADS-B position report with no integrity (i.e. NUC always "0").	**No.** The ADS-B data with NUC = 0 will be discarded by the ground system and the aircraft would be treated as if they were non-equipped.	16,612 (4.6%) ADS-B flights, or 555 ADS-B aircraft (13.7%) monitored are identified under this category.	Concerned operators should initiate prompt action for rectification, otherwise they might be requested to fly outside ADS-B airspace.



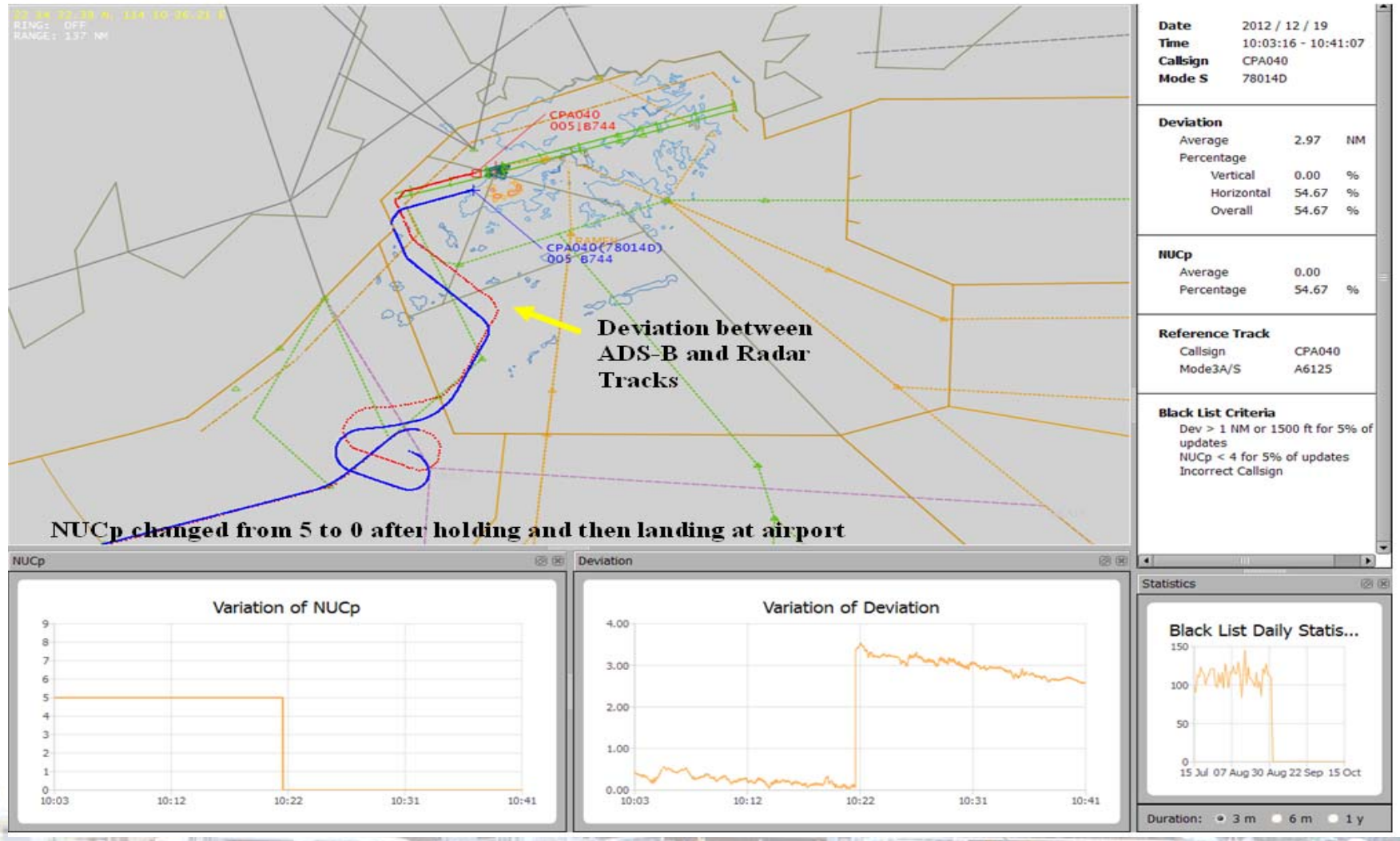
Typical Examples of Cat 3 (1/4)



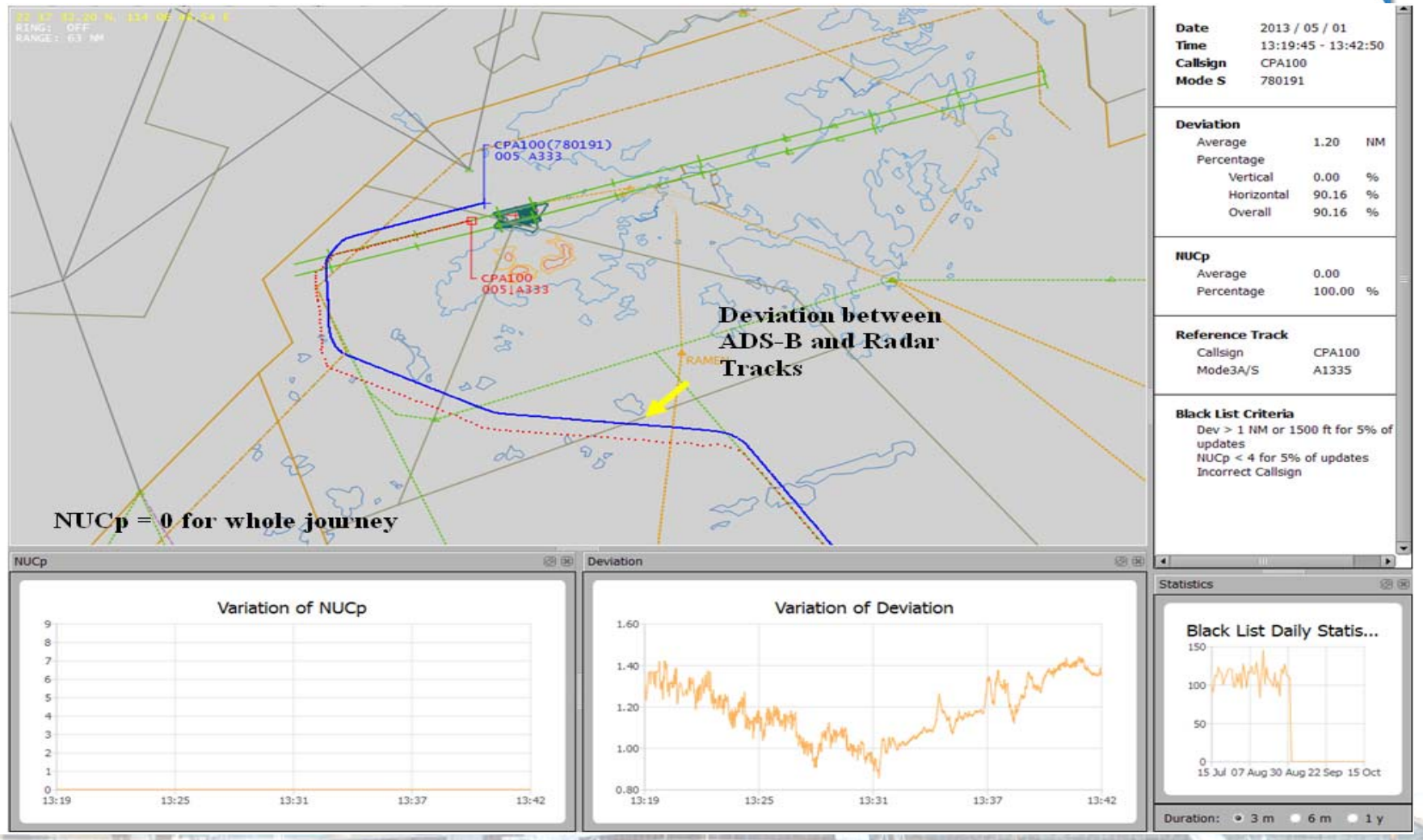
Typical Examples of Cat 3 (2/4)



Typical Examples of Cat 3 (3/4)



Typical Examples of Cat 3 (4/4)



Monitoring Scheme and Promulgation of Monitoring Results

- ADS-B equipped aircraft having incorrect FLTID (CAT 2) and/or constant NUC = 0 (CAT 3) are **not uncommon** in the region

- States/Administrations having intent to mandate ADS-B should commence their early monitoring/analysis work, report problems to concerned CAAs/airline operators for early rectification, and share their monitoring results to a centralized database

- Prudent to deliberate a period of **9 - 12 months post ADS-B mandate** to allow States to continue their assessment, collect ADS-B performance data, conduct safety assessment, while allowing sufficient time for airline operators to rectify avionics problems, and making good preparation by all stakeholders for operational use of ADS-B technology

Action by the Meeting

- Note that Hong Kong China has steered to propose an algorithm to systematically monitor performance of ADS-B equipped aircraft based on independent surveillance source, and a scheme to :

  (i) analyse and report problems into three major categories,
  (ii) share analysis results to a centralized database and
  (iii) "blacklist" problematic aircraft;

- Encourage States who are capable of performing monitoring and analysis of ADS-B equipped aircraft to share their analysis results according to the proposed algorithm/scheme;

Action by the Meeting

- Note the possible safety implications as identified by Hong Kong China on ADS-B aircraft avionics performance, and deliberate a post ADS-B mandate period of 9 - 12 months for better preparation by stakeholders on operational use of ADS-B;

- Formulate a draft Conclusion to adopt the proposed algorithm and analysis scheme into the AIGD as guidance materials; and

- Seek assistance from ICAO to establish a centralized database for storing and promulgating ADS-B performance monitoring and analysis results for enhanced aviation safety of the region

Thank you